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PRELIMINARY MANUAL

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SENSITIVE RESEARCH
MODEL LT-PS POWER SOURCE
SERIAL NO. 9008

PRELIMINARY MANUAL
MODEL LT-PS
CALIBRATION CONSOLE AC POWER SOURCE

SENSITIVE RESEARCH INSTRUMENT CORPORATION
310 Main Street, New Rochelle, New York

Manufactured by
KROHN-HITE CORPORATION
580 Massachusetts Avenue, Cambridge, Mass., U.S.A.

SECTION I - GENERAL DESCRIPTION

1. TECHNICAL SUMMARY

OUTPUT VOLTAGE: The following maximum rms voltages are selected by an OUTPUT RANGE switch: 3, 10, 30, 50, 100, 300, 750, 1,000 and 1,500 volts.

The output voltage and current are continuously adjustable with high resolution from zero to maximum, by COARSE AND FINE controls.

OUTPUT CURRENT: Maximum current and corresponding matched load impedances for each voltage range are:

VOLTAGE (RMS)	CURRENT (RMS AMPERES)	MATCHED LOAD IMPEDANCE (OHMS)
3*	15*	0.2
10	5	2
30	1.7	18
50	1.0	50
100	0.50	200
300	0.17	1,800
750	0.067	11,200
1,000	0.050	20,000
1,500	0.033	45,000

*May be less at ends of frequency range.

Additional range of 1.5 volts and 30 amperes can be supplied at additional cost.

OUTPUT POWER: Nominal 50 watts over most of the frequency range into the matched load impedance. (May be less in the three-volt range.)

AMPLITUDE STABILITY: Better than 0.01%, short term.

FREQUENCY RANGE: 20 cps to 20 kc nominal. May be operated beyond this range with reduced output power and increased distortion.

HARMONIC DISTORTION: Less than 0.25% from 20 cps to 20 kc, typically 0.1% at 50 watts over most of this frequency range.

POWER REQUIREMENTS: 105-125 volts; single phase; 50 - 60 cycles, 600 watts.

FORM: The complete instrument, consisting of three separate chassis, is housed in a standard cabinet 40" high, 22" wide and 19" deep. Shipping weight: 435 lbs.

SECTION I - GENERAL DESCRIPTION

2. DESCRIPTION

The Model LT-PS was designed for use in Standards Laboratories to supply adequate power for calibration, by the comparison method, of all ac voltmeters and ammeters normally used for laboratory measurements. This instrument is also extremely useful as a general purpose Variable Frequency Power Source. The exceptionally low harmonic distortion of the output voltages and currents from this instrument permits accurate calibration of meters which are sensitive to harmonic frequencies. Exceptionally good short-term amplitude stability, also essential for accurate meter calibration, is achieved by a new and exclusive Krohn-Hite oscillator cirucit development. 40 watts of power are available over the frequency range from 20 cps to 20 kc with less than 0.25% total harmonic distortion, typically 0.1% at 50 watts over most of this frequency range.

SECTION II - OPERATION

The Model LT-PS is shipped completely assembled. Before operating, the cable connections in the rear should be checked to ensure that none has been jarred loose during shipment. The line cords from the Amplifier, Model LT-PS1, and the Oscillator, Model LT-PS2, should be connected to the power outlets at the rear of the Control Unit, Model LT-PS3, to allow the Model LT-PS to be turned on by the POWER switch on the front panel of the Control Unit. At the rear of the Amplifier, which is the top instrument, there is a HIGH-LOW line switch that should be set to the LOW position if the line voltage is between 105 and 114. For a line voltage between 114 and 125, this switch should be in the HIGH position.

Before connecting the line cord of the Control Unit to the power line, the POWER ON-OFF switch should be in the OFF position.

1. After connecting the line cord to the power line, the COARSE AMPLITUDE CONTROL should be set to the maximum ccw position before switching the power ON. Switch the power on and wait one minute before advancing the AMPLITUDE CONTROLS. This interval allows time-delay relays in the Amplifier and Control Unit to operate.

The Model LT-PS Power Source can be used immediately. However a 30 minute warm up time is recommended to obtain optimum amplitude stability.

2. After adequate warm up time the load may be connected.

3. Obtain the desired operating frequency by proper setting of the FREQUENCY MULTIPLIER switch, all three banks of FREQUENCY-CPS pushbuttons and the frequency VERNIER control.

All units except the Oscillator are designed to operate in the 20-20,000 cps frequency range only. Operating outside of this range will result in degraded performance.

4. Set the FREQUENCY RANGE switch to include the operating frequency.

5. For proper load impedance matching, the OUTPUT RANGE switch should be set to the lowest range which includes the voltage desired.

6. Advance the AMPLITUDE CONTROLS to the voltage desired. Do not exceed rated output as indicated by the PERCENT OUTPUT meter. Excessive output will overload the Amplifier and release the circuit breaker.

CAUTION: It is especially important to return the COARSE AMPLITUDE CONTROL to the maximum ccw position before operating any switches.

TEST JACK VOLTAGES

Adjustments have been made at the Factory to set the voltage on each of the two test jacks, TP 1 and TP 2, located on the front panel of the Amplifier. Before extensive use of the Model LT-PS it is recommended that these voltages be checked. Due to feedback circuit design in the Amplifier, gradual deterioration of tubes or components will ordinarily not be detected until complete failure occurs. For this reason it is suggested that a periodic check and readjustment of the output tube plate currents be made after every 500 hours of use in order to maintain lowest distortion operation. These plate currents can be checked by measuring the dc voltage between the chassis and test jacks, TP 1 and TP 2, in the following manner:

The adjustments should be made with the Model LT-PS warmed up for at least 30 minutes. The COARSE AMPLITUDE CONTROL on the Control Unit should be set to the maximum ccw position.

With the voltmeter connected between the two test jacks, the front panel screwdriver adjustment marked BALANCE should be turned until the reading is zero, indicating balance of plate currents. A clockwise turn of this adjustment will make the voltage at TP 1 go more positive. The response of the voltmeter to this adjustment is very slow (the time constant is about 10 seconds) because the full feedback of the Amplifier is opposing. Making this adjustment in several small steps and observing the effect of each, might be easier than trying to turn the pot slowly enough for the voltmeter to follow.

When both test points have stabilized at the same voltage, the voltmeter should be connected between one test point and chassis (black binding post on the Control Unit can be used) and the reading adjusted to between .95 and 1 volt with the front panel screwdriver adjustment labeled BIAS. This is a much faster adjustment than the BALANCE.

If the adjustments required in either of these steps have been considerable, a small interaction between the BALANCE and BIAS adjustments may be present and the previous procedure should be repeated.

SECTION II - OPERATION

FUSING

The Amplifier and Oscillator are individually fused. Also the complete LT-PS is fused with a 6 1/4 Ampere SLOW slow fuse on the panel of the Control Unit. In the event that the main fuse blows the pilot light on both the Amplifier and Oscillator will go out. If either one of the other fuses blow the corresponding instrument pilot light will go out.

SECTION III - REMOVAL OF INSTRUMENTS FROM THE RACK

The Amplifier may be taken out of the rack by removing the four panel screws in front and the two screws in the rear holding the small bracket to the slide rail. The two screws fastening the small bracket to the Amplifier should not be removed as these hold the bottom plate to the chassis.

The Oscillator may be taken out by removing the four front panel screws and the two screws in the rear which secure the instrument to the slide rails.

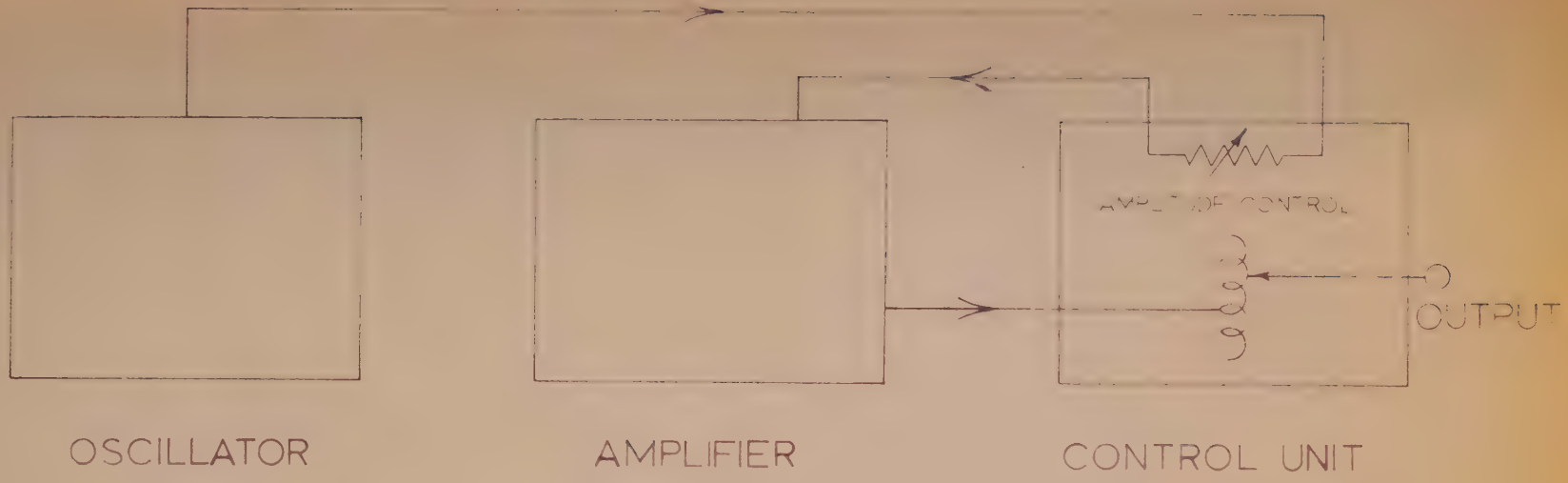
Removal of the Control Unit is achieved by removing the eight front panel screws. After the front panel screws have been removed, the screws holding the side braces which are inside of the rack should be taken out. There are three screws on each side brace one toward the front and two on the rear.

NOTE: The transformers may produce an audible tone when operating at high levels. This is normal and should not be interpreted as a symptom of failure.

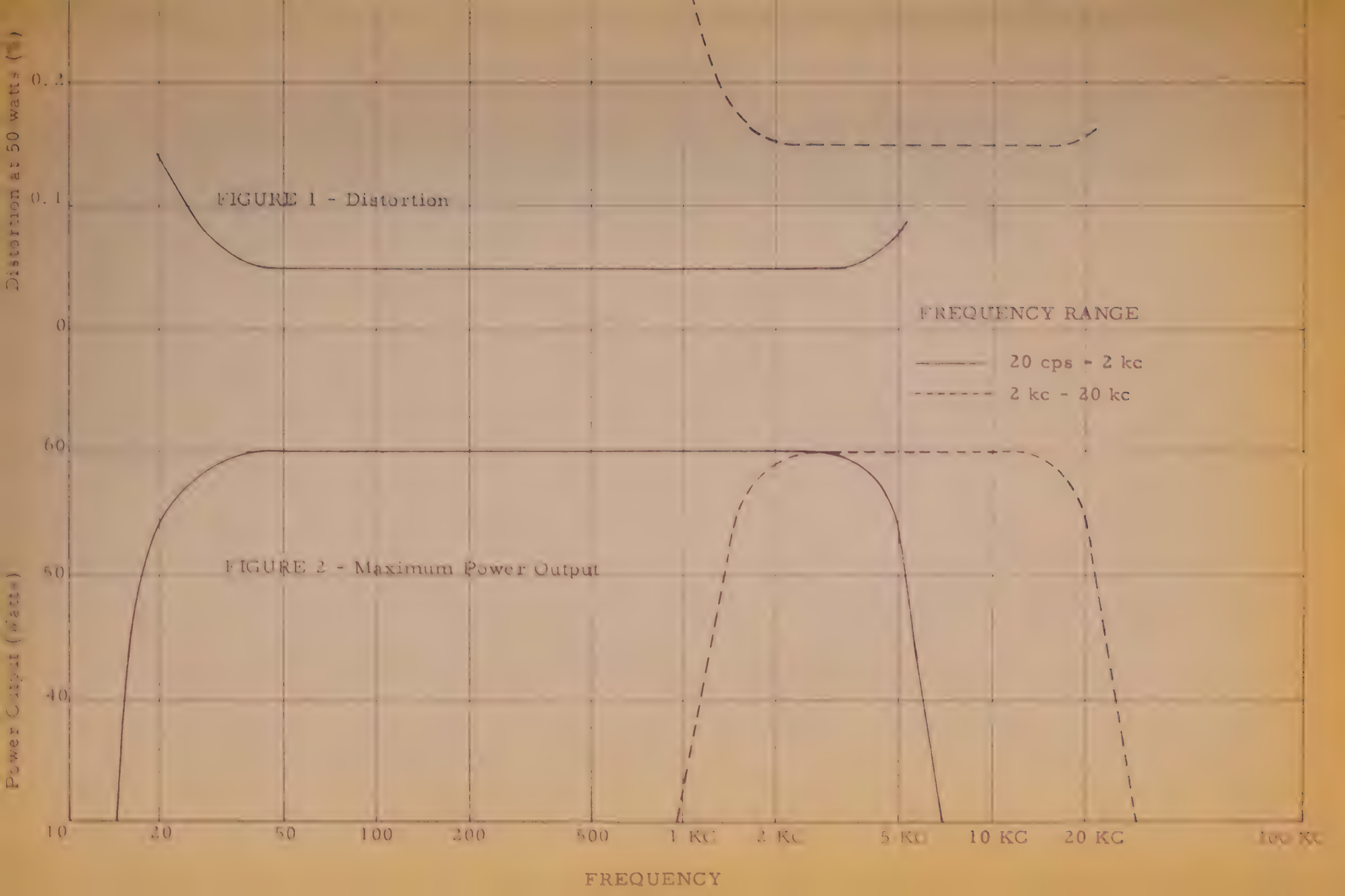
The Model LT-PS2 and Model LT-PS1 are modified versions of the standard Model 440-A push-button oscillator and the Model UF-101A Ultra-low distortion power amplifier. Accordingly the Operating and Maintenance Manuals of both these instruments are enclosed since they can be used for the major portion of the maintenance problems.

The Model LT-PS2 differs from the Model 440-A in that the RMS VOLTS control, the front panel OUTPUT terminals, the .01 position of the FREQUENCY MULTIPLIER switch and the POWER ON-OFF switch have been removed. In addition, the AVC circuit has been modified extensively and a constant temperature oven has been incorporated to house the critical components. The square wave circuitry has also been removed.

The Model LT-PS1 is similar to the Model UF-101A except that all of the front panel controls and terminals have been removed and the feedback circuits have been modified to allow remote operation.



BLOCK DIAGRAM


Distortion at 50 watts (%)
0.2
0.1
0
FIGURE 1 - Distortion
FREQUENCY RANGE
20 cps - 2 kc
2 kc - 20 kc
60
50
40
Power Output (Watts)
FIGURE 2 - Maximum Power Output
10
20
50
100
200
500
1 KC
2 KC
5 KC
10 KC
20 KC
100 KC
FREQUENCY

All voltage and resistance values measured from the pins of each socket to ground (chassis).

Voltages measured with instrument operating from a 119 volt 60 cps source and line voltage switch in HIGH position. DC voltages measured with a VTVM having an input resistance of 11 megohms.

NOTE: All resistance values in OHMS. K = 1,000 M - 1,000,000

Resistance measured from L302 to ground (chassis) is 17K.
Resistance measured across C306B is 60K when the positive (+) ohmmeter lead is connected to ground (chassis).

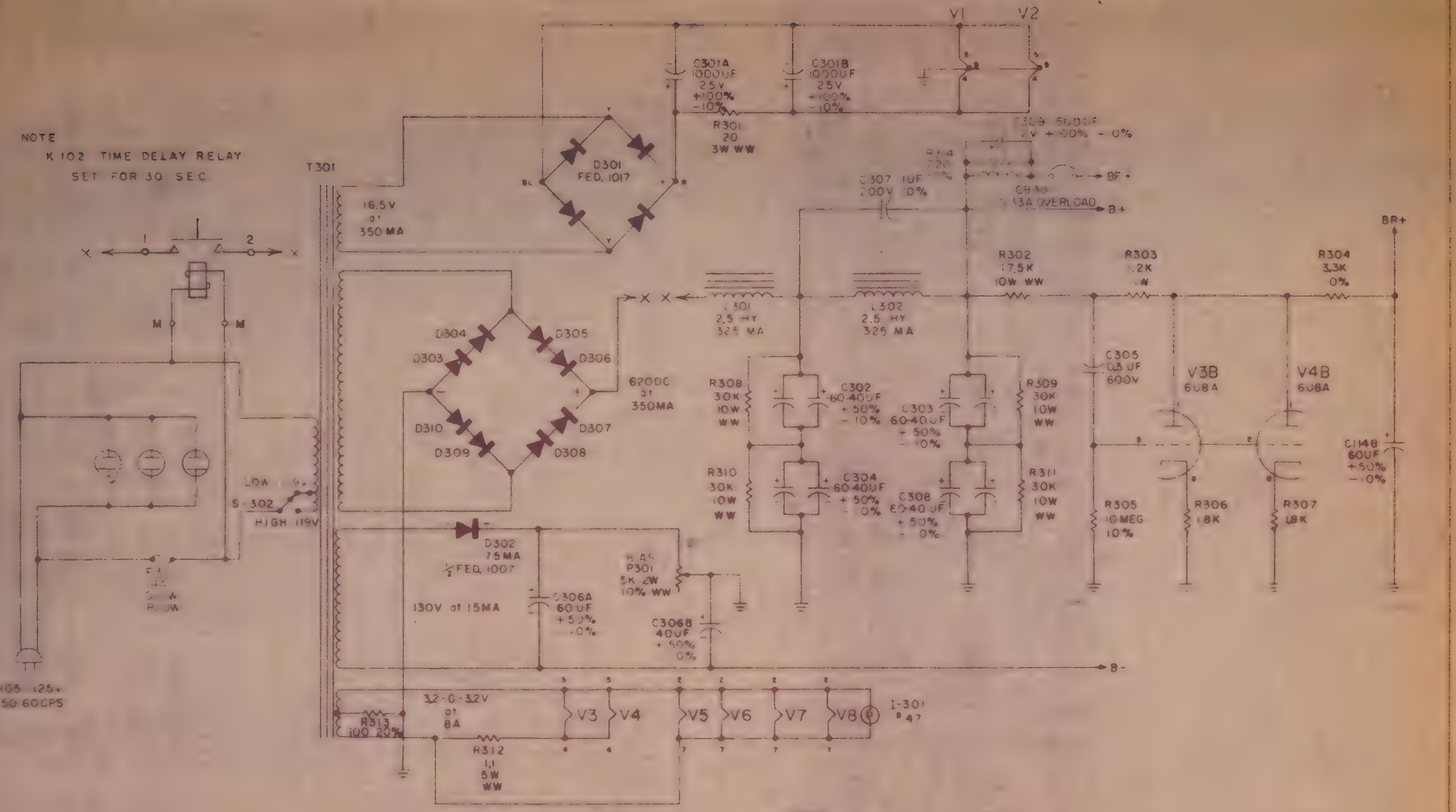
Variations of up to ±20% in all readings can be expected.

Tube No.	Tube Type		PIN NUMBER								
			1	2	3	4	5	6	7	8	9
V1	12AX7	V	160	0	1.1	6.8	-7.0	160	0	1.1	0
		R	110K	7M	300	5	5	110K	7M	300	0
V2	12AX7	V	160	0	1.2	6.8	-7.0	160	0	1.2	0
		R	110K	660K	330	5	5	110K	660K	330	0
V3	6U8A	V	310	0	295	2.0ac	3.0ac	305	29	10	0
		R	27K	25M	32K	90	90	65K	50K	2.2K	10M
V4	6U8A	V	310	0	295	2.0ac	3.0ac	310	29	8.5	0
		R	27K	25M	32K	90	90	65K	50K	2.2K	10M
V5	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--
V6	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--
V7	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--
V8	6550	V	0	3.0ac	615	605	-15	--	3.0ac	45	--
		R	0	90	18K	19K	200K	--	90	675	--

Model ~~EDS-102R~~ LT-PS1 - TABLE OF VOLTAGE AND RESISTANCE MEASUREMENTS

Sense leads, Pins 1 and 2 on J102, Serial Nos. ~~104~~ 9002 to ~~117~~ 9003, should be connected to output (1 to hot side and 2 to ground).

On Serial Nos. ~~113~~ 9004 and above the black lead connected to the hot side and the white lead to ground.



NOTES

(1) RESISTANCES IN OHMS, K=1000, MEG=1000000.

(2) RESISTORS ±5% ½ WATT UNLESS OTHERWISE SPECIFIED.

(3) CAPACITANCES IN MFD UNLESS OTHERWISE SPECIFIED.

(4) CAPACITORS ±20% 500 WVDC UNLESS OTHERWISE SPECIFIED.

(5) S-301 SHOWN IN OFF POSITION.

(6) D303 TO D310 ARE RATED 800 PIV — 500MA PER UNIT

MODEL ~~LPS-102B~~ LT-PS1

REV STR 1-8-60

DATE 4-4-59

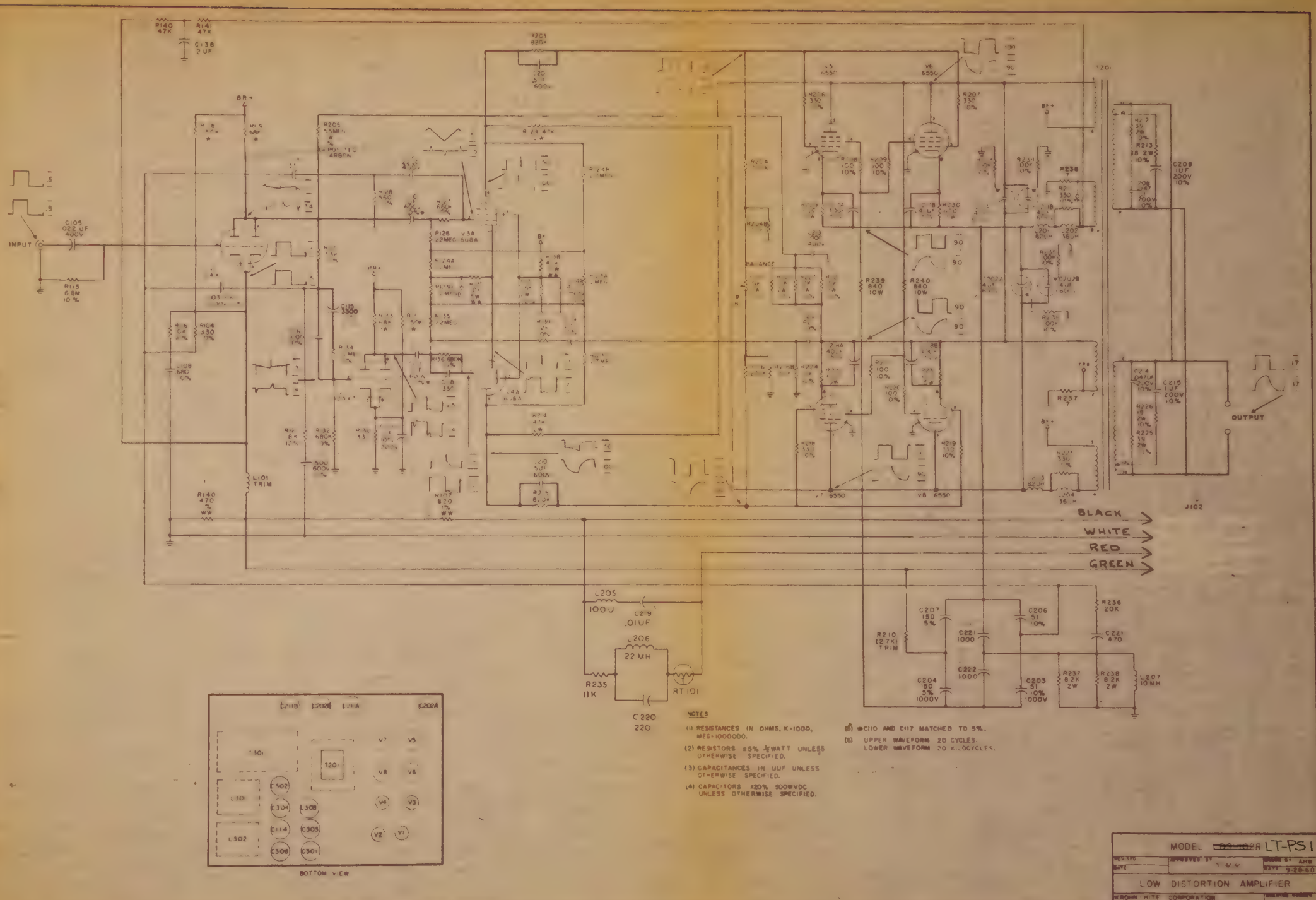
DRAWN BY AHW

APPROVED BY

POWER SUPPLY

KROHN-HITE CORPORATION
CAMBRIDGE, MASSACHUSETTS

DRAWING NUMBER



NOTES

(1) RESISTANCES IN OHMS, K=1000, MEG=1000000.

(2) RESISTORS ±5% ½WATT UNLESS OTHERWISE SPECIFIED.

(3) CAPACITANCES IN UUF UNLESS OTHERWISE SPECIFIED.

(4) CAPACITORS ±20% 500WVDC UNLESS OTHERWISE SPECIFIED.

(5) ●C110 AND C117 MATCHED TO 5%.

(6) UPPER WAVEFORM 20 CYCLES.
LOWER WAVEFORM 20 KILOCYCLES.

MODEL ~~LBO-102A~~ LT-PS1

LOW DISTORTION AMPLIFIER

DRAWN BY AMB

DATE 9-28-60

RONAN - MITE CORPORATION
CAMBRIDGE MASSACHUSETTS

RESISTANCE MEASUREMENTS OF OUTPUT TERMINALS

CONTROL UNIT

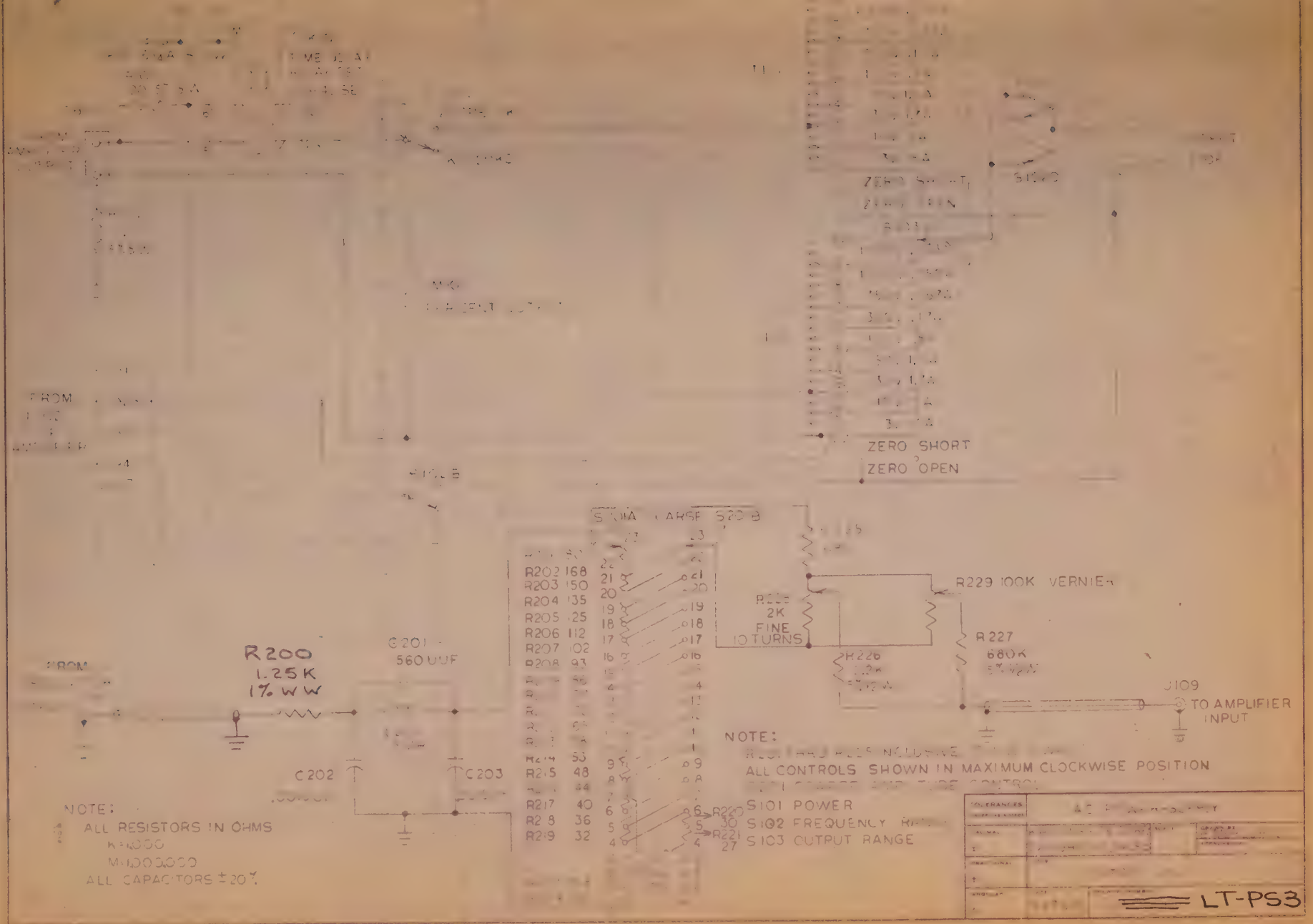
MODEL ~~EDS-501~~ LT-PS3

OUTPUT RANGE	FREQUENCY RANGE	
	20 cps-2 kc	2 kc-20 kc
Zero open	∞	∞
Zero short	.012	.012
3V	.032	.011
10V	.076	.012
30V	.772	.060
50V	1.49	.103
100V	4.44	.207
300V	66.7	3.86
750V	221	17.3
1000V	274	25.2
1500V	395	36.5

All resistances in ohms.

Resistances measured with Leeds and Northrup Resistance Bridge, Model 5305.

Resistances measured directly across the output terminals.


ZERO SHORT
ZERO OPEN
R229 100K VERNIER
R228 2K FINE 10 TURNS
R227 680K
R226
J109
TO AMPLIFIER INPUT
R200 1.25K 1% WW
C201 560 UUF
C202
C203
R202 168
R203 150
R204 135
R205 125
R206 112
R207 102
R208 93
R217 40
R218 36
R219 32
NOTE:
ALL CONTROLS SHOWN IN MAXIMUM CLOCKWISE POSITION
S101 POWER
S102 FREQUENCY
S103 OUTPUT RANGE
NOTE:
ALL RESISTORS IN OHMS
ALL CAPACITORS ±20%
LT-PS3

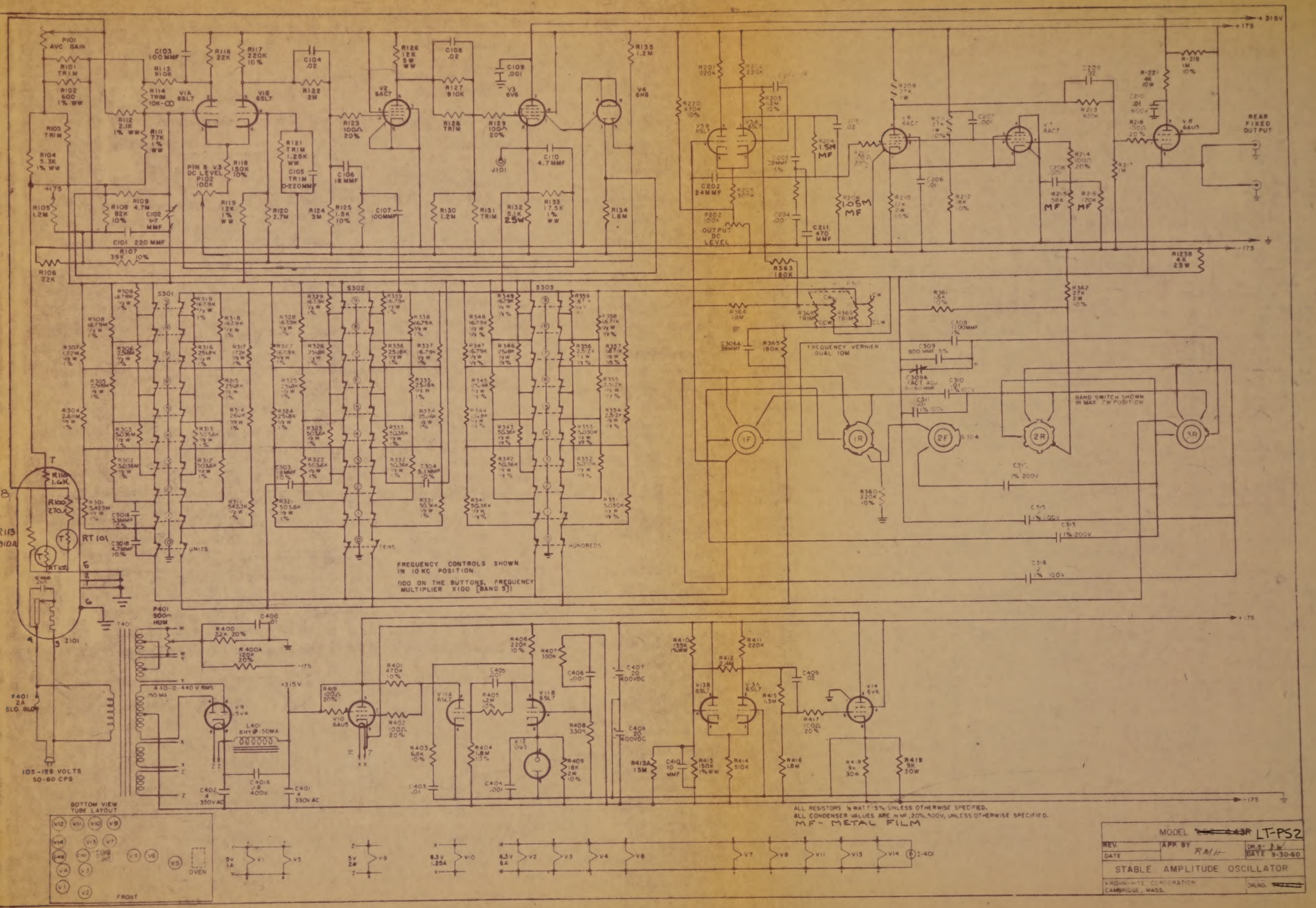
meter used for the measurements was a V. T. V. M. with an impedance of 11 megohms. All measurements were made with the Frequency Multiplier on 100 at a frequency of 10,000 cps and 115 volt line.

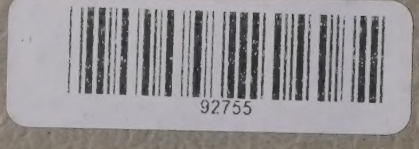
Resistances measured in the same manner except with line cord removed.

Variations up to ±20% to be expected.
All resistances in ohms K = 1,000 M = 1,000,000

TUBE NO.		PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
1	V	0±1	150	1.4	0±1	110	1.4	-3	-3	--
	R	2K	48K	200K±50K	600±400	250K	200K±50K	2.2K	2.2K	--
2	V	0	-3	0	-3	0	175	-3	125	--
	R	0	2.2K	0	1.2M	0	30K	2.2K	40K	--
3	V	0	-3	330	175	-72	0±1	-3	0±1	--
	R	0	2.2K	1M	30K	520K	50K	2.2K	6K	--
4	V	0	-3	-10	0	0	0	-3	0	--
	R	0	2.2K	80K	0	54K	54K	2.2K	0	--
5	V	0	110	1.3	0±1	108	1.3	-3	-3	--
	R	0	240K	350K±50K	50K	220K	350K±50K	2.2K	2.2K	--
6	V	0	-3	-55	-57	-55	42	-3	100	--
	R	0	2.2K	17K	850K	17K	14K	2.2K	55K	--
7	V	0	-3	-55	-57	-55	42	-3	0	--
	R	0	2.2K	17K	39K	17K	14K	2.2K	0	--
8	V	-26	-3	0±1	0±1	110	-26	-3	175	--
	R	440K	2.2K	1K	1K	1M	440K	2.2K	30K	--
9	V	--	330	--	-180	--	-180	330	330	--
	R	--	1M	--	2.2K	--	2.2K	1M	1M	--
10	V	140	175	175	110	315	-175	175	315	--
	R	1.5M	30K	30K	245K	1M	2.2K	30K	1M	--
11	V	-2	140	0	-85	110	-85	-3	-3	--
	R	850K	1.5M	0	165K	240K	19K	2.2K	2.2K	--
12	V	--	-85	0	-85	0	-68	-85	--	--
	R	--	19K	0	19K	0	10M	19K	--	--
13	V	0	110	2	0±1	175	2	-3	-3	--
	R	0	220K	560K	80K	30K	560K	2.2K	2.2K	--
14	V	0	-3	330	175	-4.6	--	-3	0	--
	R	0	2.2K	1M	30K	850K	--	2.2K	0	--
VEN	V	0	0	115AC	115 AC	0	0	0	0	
	R	0	0	--	--	0	0	280	260	

Model ~~LDC-44~~ LT-PS2 - Table of Voltage and Resistance Measurements


+315V
+175
-175
REAR FIXED OUTPUT
S301
S302
S303
UNITS
TENS
HUNDREDS
FREQUENCY CONTROLS SHOWN IN 10 KC POSITION.
100 ON THE BUTTONS, FREQUENCY MULTIPLIER X100 (BAND 5)
FREQUENCY VERNIER DUAL 10M
BAND SWITCH SHOWN IN MAX FW POSITION
1F
1R
2F
2R
3R
RT 101
105-125 VOLTS 50-60 CPS
4-10-0-440 V RMS 150 MA
L401 8HY@150MA
OUTPUT DC LEVEL
PIN 8 V3 DC LEVEL
BOTTOM VIEW TUBE LAYOUT
FRONT
OVEN
ALL RESISTORS ½ WATT 5% UNLESS OTHERWISE SPECIFIED.
ALL CONDENSER VALUES ARE IN MF. 20%, 500V, UNLESS OTHERWISE SPECIFIED.
MF - METAL FILM
MODEL LT-PS2
REV.
DATE
APP BY
DR BY
DATE 9-30-60
STABLE AMPLITUDE OSCILLATOR
KROHN-HITE CORPORATION
CAMBRIDGE, MASS.
DRG. NO.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